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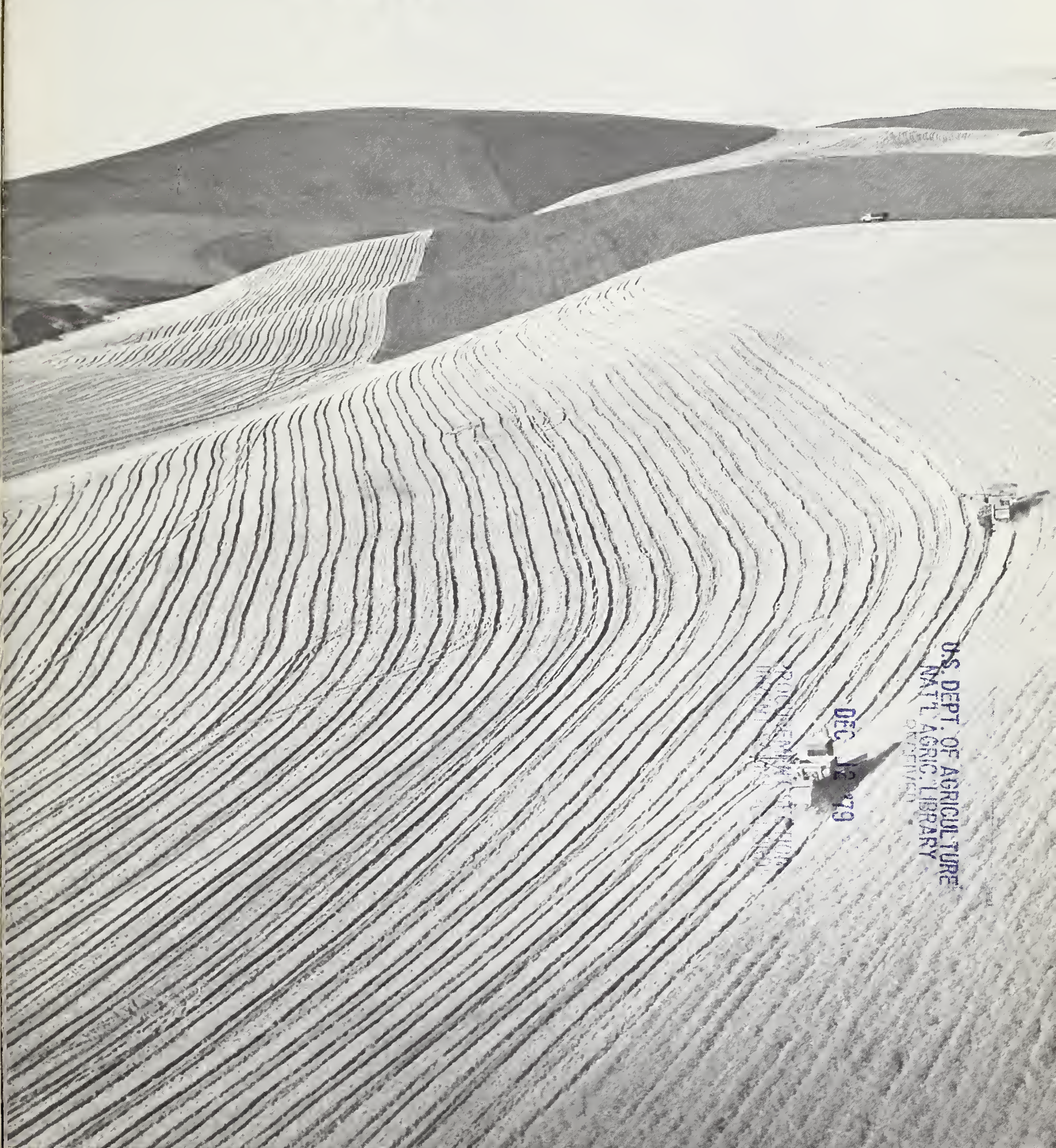

A National Nutrition Policy*

D. Mark Hegsted, Administrator
Human Nutrition Center, SEA

The nutrition policy of this country is —and always will be—to provide a nutritionally adequate diet to everyone or, at least, to make an adequate, nutritious food supply accessible to everyone. Moderation is the key to a viable nutrition policy, which will provide the American people with an optimal diet for health.

Responsibility. A characteristic feature of nutrition is that it is not possible to organize it or discuss it in a very logical fashion. Nutrition is practically everybody's business, and almost every human activity impinges on it. The food and agricultural industries have a major responsibility to provide a nutritious food supply to the population served, but it must be abundantly clear that we are concerned with a complex system that does much more than provide for nutrient needs. . . .

Change. The major change that will occur in nutrition policy is increased emphasis toward moderation of American dietary patterns and some limitation of intake of various foods and food constituents. Shifting our emphasis toward more concern about over-consumption of certain foods or food constituents certainly does not mean less concern about adequate intake of essential nutrients. . . .

Balance. Everyone must understand, that excessive consumption of anything is certainly undesirable. It is not fair to the consumer for every group to tout the nutritional advantages of each and every product — however trivial — and ignore their disadvantages. A more balanced presentation is required — certainly in nutrition education efforts, and probably in labeling, advertising, and promotion. . . .

Application. The issue is not natural vs. processed foods. The issue is: How to apply the best nutritional knowledge. Nutrition education is not nearly as effective as many of us would like it to be. Yet, in the long run, one does expect nutritional advice to modify food patterns. The challenge to the food industry is to produce products with the kinds of nutritional properties that are desirable and which also combine other characteristics of flavor, consistency, convenience, and price that do make them acceptable. . . .

Guidelines. New dietary guidelines will be developed. These will increasingly stress some limitation of consumption of factors or materials known to create, or suspected of creating, undesirable effects. As in the development of the Recommended Daily Allowances (RDAS), the actual levels specified will be based on judgment and gradually change. . . .

Opportunity. It is unfortunate that the development of new dietary guidelines which modify past practices — particularly when combined with great public interest — results in a period of confusion and debate. These arguments — often more a matter of quantification than of principle — diminish confidence in the scientific community. We, in the nutrition community, now have greater opportunities to modify food and agricultural practices than we ever have had, but we are in danger of losing that opportunity unless we subdue or resolve some of these arguments. . . .

Leadership. We have not only the opportunity, but the responsibility to play a primary role in the development of new policy and guidelines. There are others, however, who would gladly assume a primary role, and we will forfeit the opportunity unless we demonstrate a clear, positive, and progressive leadership.

* Excerpts from Dr. D. Mark Hegsted's article published in the May 1979 issue of the *Journal of The American Dietetic Association.*

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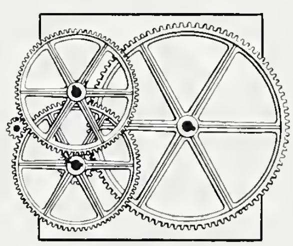
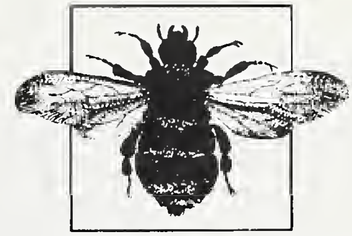
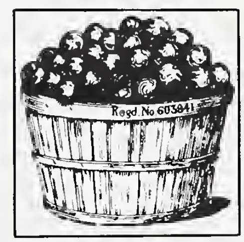
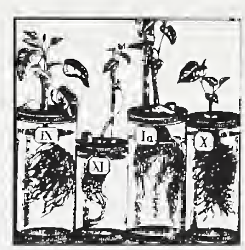
Photos on pp. 12, 14, and 15 courtesy Grant Heilman.

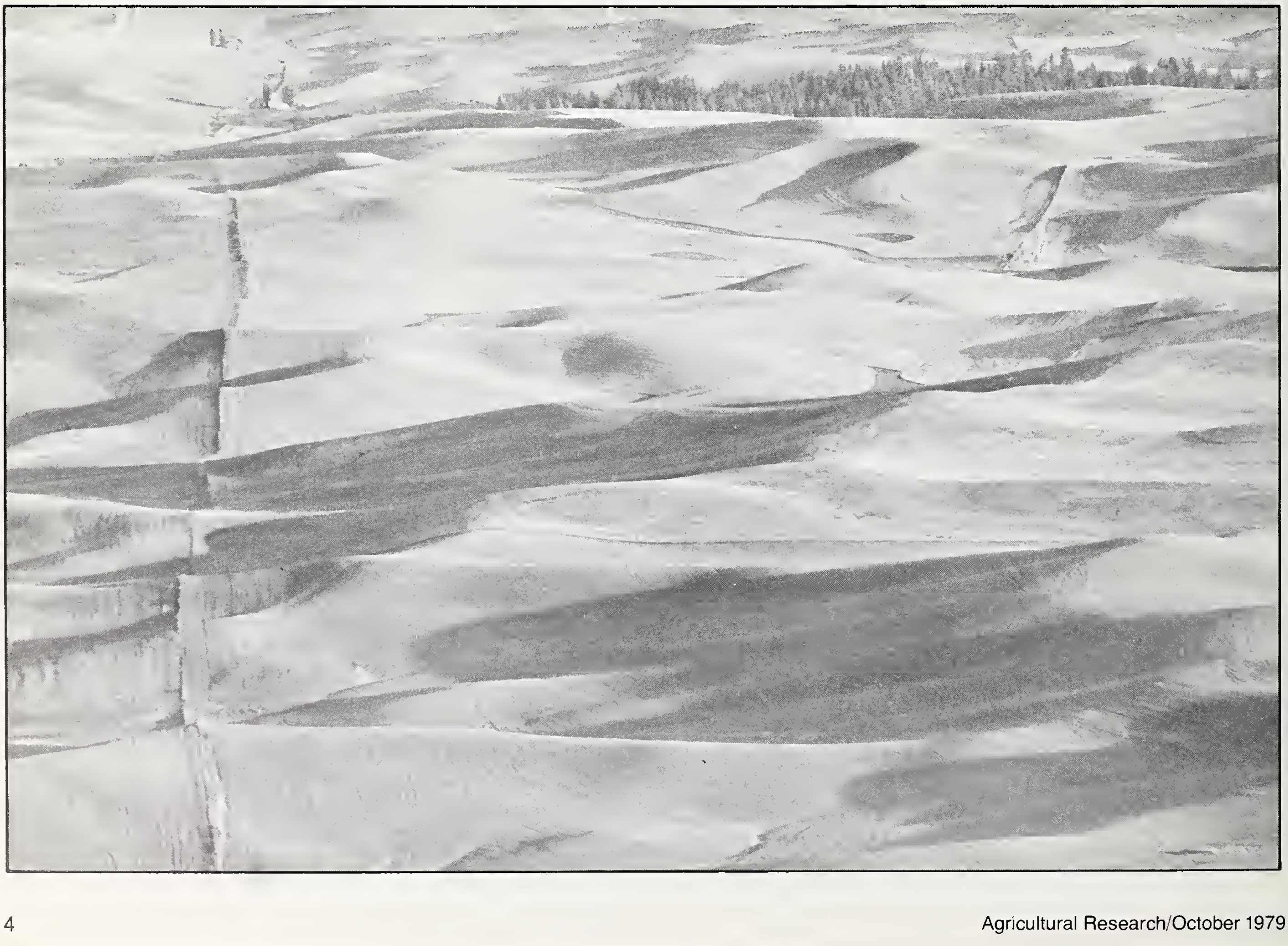
Cover: The 8.5 million acres of cropland in the Palouse are the target of a joint SEA, State Agricultural Experiment Station, and private grower research program dedicated to coping with soil erosion—our story begins on page 4. (Photo courtesy Grant Heilman.)











Learning from the Past

"Those who do not learn from the past are doomed to repeat it," said historian George Santayana in one of humanity's most enduring aphorisms. One key lesson to be learned from history is that a civilization maintains its greatness only so long as it is able to feed itself and it is able to feed itself only so long as it maintains its rich, food-producing soil. The once proud and mighty civilizations of ancient Egypt, Babylon, and Greece were literally washed away.

The 8.5 million acres of cropland in the Palouse region of the U.S. Pacific Northwest, an area that includes parts of eastern Washington, northwestern Idaho, and northeastern Oregon, features some of the world's most fertile and productive topsoil. It's been boasted by agricultural experts in the area that no place in the world, under dryland conditions, grows more wheat per acre. Barley, peas, and oats also flourish.

Each year, more than 110 million tons of the topsoil responsible for this splendid production are lost to erosion. It's estimated that during the last 100 years, erosion has removed more than 40 percent of the original topsoil, a loss of an inch of topsoil every 15 years — an inch that took Nature at least 800 years to form. The land beneath this topsoil is drastically less productive and increasingly more erosive. Unless the soil erosion in the Palouse is checked, one day, in the not too distant future, food production may simply stop.

Complicating the problem of soil erosion is the difficulty in drumming up public support for efforts to control it. Erosion is insidious, unlike, for example, water pollution. People support efforts to control water pollution because people are readily aware of the problem and can react to it. Anyone can look at a river or a stream, see that it is dirty and be made sick by the knowledge. But the ravages of erosion are often not so readily apparent, nor does the implication of the damage, when visible, register so easily with an untrained beholder.

Yet, sadly enough, it is much easier to live with dirty water than with soil erosion, for dirty water can be cleaned, whereas lost soil cannot be replaced. As further irony in this ecological tragedy, sediment from soil erosion is responsible for about 80 percent of all water pollution in this country.

Above: Pulverized soil, from intense cultivation, loses its stability and is a contributing factor to erosion in the Palouse (0779X950-34A). The divided slope practice—breaking up the slope into different tillage and cropping systems—is one way to reduce soil loss and water runoff from steep hillsides (0579X646-15A).

Opposite: Nearly 600 tons per acre of fertile Palouse topsoil has washed away since the days of horse-pulled reapers in the 1920's (photo courtesy State Historical Society of Wisconsin). Ninety percent of this erosion occurs in the winter months—when the smooth seed beds of winter wheat fields are most susceptible to runoff and sedimentation (0779X945-15).

STEEP

In the Palouse region, something is finally being done about the situation. Cognizant of the spirit of Santayana's declaration, SEA has joined with the Agricultural Experiment Stations of Idaho, Oregon, and Washington, and with Palouse growers in a coordinated research program dedicated to "... developing the knowledge necessary to cope with soil erosion ..." in the Palouse. This coordinated program, which was initiated by the growers themselves in the spring of 1974, is called STEEP — Solutions to Environmental and Economic Problems.

Under the broad STEEP program, federal and state researchers, enveloping a wide range of scientific disciplines, have been brought together for the first time ever to focus on this single problem of erosion. Funding for STEEP and STEEP-related projects comes from private industry as well as federal and state governments.

"STEEP is the best example of a coordinated research effort I have ever been associated with," says Stanley N. Brooks, former director of the SEA-Agricultural Research, Washington-Oregon area, in Pullman, Wash. "It can serve as a model for the rest of the Nation."

Summer Fallowing

The Palouse terrain has moderate to extremely steep slopes. Annual rainfall averages 18 or more inches. These physical characteristics of course contribute to the terrible erosion problem in the area. But without question, the lion's share of responsibility for the problem belongs to the time-honored farming practice of summer fallowing.

Summer fallowing is the practice of holding a cropland idle on alternate years to conserve soil moisture. During the summer, the idle cropland is extensively cultivated or tilled to control weeds. From a farming standpoint, on a short-term basis, summer fallowing can be a highly profitable practice. It provides good seed beds and excellent weed control, and produces a soil mulch that acts as a barrier to prevent soil water from rising under capillary pressure to the land's surface and evaporating.

Crop yields in the year following the idle period are usually outstanding because the soil contains more than one season of stored water.

Many Palouse farmers have been practicing summer fallowing for so long it's become a custom — a routine habit. As recently as 20 years ago, federal agencies recommended summer fallowing as a water conservation method. But in the words of Robert I. Papendick, a SEA soil scientist at Pullman, who has studied erosion problems long before the advent of STEEP, "Summer fallowing is the worst possible thing to do, in terms of erosion." It is easy to see why.

Under summer fallow, fields are tilled until the soil is pulverized into tiny particles, like finely ground flour, that are easily washed away by runoff. Verle G. Kaiser, a retired agronomist formerly with USDA's Soil Conservation Service, made an annual erosion damage survey in the region for 39 years. He says that, "For every bushel (60 pounds) of wheat grown in the Palouse, 1,200 pounds of topsoil are lost." On a short-term basis, summer fallowing may be an agricultural and

economic boon, but all evidence indicates that for this region in the long run it's a bankrupt policy.

Conservation Tillage

Since it is a combination of steep terrain, rainfall, and farming practices that plague the Palouse with such a severe erosion problem, and nothing significant can be done about the weather or the shape of the land, STEEP's emphasis has been on changing farming practices.

The chief practice being investigated by the STEEP team is conservation tillage, an operation that calls for minimal or no tillage at all. New crops are seeded directly into the surface residue from the previous year's crop. Crops may be rotated, but no land is left idle for a year and no soil is turned over. Soil is either broken up into thick clods that disrupt the soil capillary activity that would bring soil water to the surface, or else it is left completely undisturbed.

The residue from the previous crop

Above: Sediment-laden water is the main source of pollution in the streams draining the Palouse during the winter runoff period (0579X645-30).

Right: Don McCool, of the Palouse Conservation Field Station (PCFS), inspects sediment damage to winter wheat (0779X942-25).

Opposite, Top: The rill meter, designed by Don McCool (left), measures rill (miniature gulley) erosion and graphs the surface's contour through a metal rod system. McCool and research technician Bill O'Brien prepare to photograph the meter's readings (0579X646-5).

Opposite: This steep embankment, resulting from repeated downhill plowing, shows the effects of tillage erosion (0779X941-35).

Top: SEA scientists, using surface residues to protect against soil erosion, are also studying what effects, if any, residues have on winter wheat crown development (0579X640-14A).

Bottom: Verlan Cochran, PCFS, compares tilled and no-till winter wheat plots. The no-till plots, with wheat straw removed from the seed zone to avoid phytotoxicity from surface crop residues, had superior growth (0779X940-18).

is highly effective at preventing soil erosion and the soil left undisturbed or broken up into clods is not easily washed away. Says Papendick, "If growers in the region practiced conservation tillage in the best possible way, erosion could be reduced immediately by 70 to 80 percent."

In addition to erosion control, conservation tillage, also known by such names as no-till, reduced tillage, stubble mulch, zero-till, and chemical fallow, offers savings in the labor and energy required to tear out the old crops and deep-plow the soil. Long-term yields will benefit not only because of soil conservation, but also because organic material (the previous year's residue) is being added to the soil and the land is not left idle every other year.

Presently, the problems posed by conservation tillage are numerous. Number one on the problem list is weed control. Weeds posed less problem under summer fallow but unless growers are careful in their weed control efforts, weeds will thrive under conservation tillage. Various herbicides have been developed that can control the weeds but the application cost is high and problems with herbicide runoff into water bodies must be looked into.

Sowing seed directly through residue into soil will require different types of planting equipment and a change in fertilization application techniques.

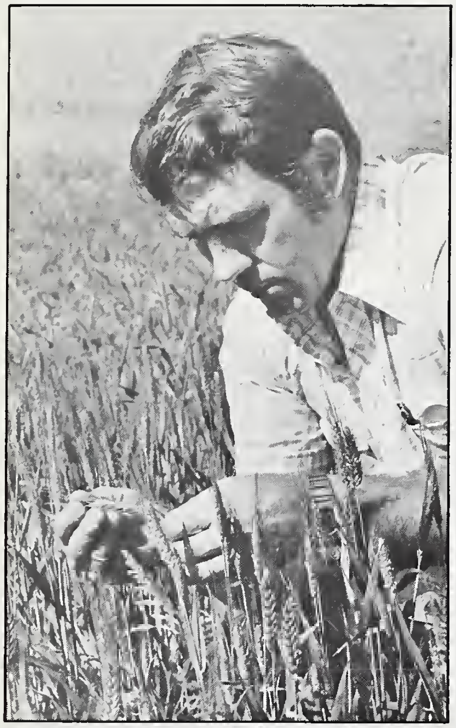
Phytotoxicity becomes a major problem too, for as seed passes through the residue, it picks up diseases that crops have never had to deal with before. A commercial drill modified by Clarence Johnson, SEA agricultural engineer, along with Kenneth Johnson, an Oregon State University engineer, both at Pendleton, Ore., may help solve some of these problems by shoving the residue aside before planting the seed and putting fertilizer beneath the seed in a single operation.

Under conservation tillage, there is a need for new wheat varieties. Today's leading wheat varieties have been bred and developed to fit into conventional tillage management systems, such as summer fallow. Says Robert E. Allan, plant geneticist and leader of the SEA wheat breeding program at Pullman, "There are no current wheat varieties that will yield as much under conservation tillage as under conventional tillage."

Since soil temperatures in early spring under conservation tillage are lower than temperatures under summer fallow, a wheat variety is needed that will germinate and grow in cooler temperatures. Differences in nutrients, moisture available in the soil under the two practices, and insect, disease, rodent, and weed problems must also be taken into account. Allan's group has embarked on a "survival of the strongest" selection campaign that will take several years to complete, but Allan feels "the odds are good" that variety problems will be surmounted.

"Ultimately, the best way to control erosion in the Palouse, is to get grass into the crop rotation system," says Chester L. Canode, SEA agronomist at Pullman. He is trying to do just that, working with blue-grass seed on a rotation system with the area's predominent annual crop. Using such a rotation system, speculates Canode, erosion losses could be cut to practically zero.

The fertile topsoil of the Palouse is gradually being washed out to sea. This relentless, on-going devastation of the land is taking place elsewhere across the United States and throughout the rest of the world. Solutions to the problem of erosion are neither simple nor easy, nor are remedies likely to be soon forthcoming. STEEP represents an attempt to learn from the past and avoid repeating it. (By Lynn Yarris, SEA, Oakland, Calif.)



Top: Larry Morrow, PCFS, evaluates growth of winter wheat, the main cash producing crop in the Pacific Northwest (0779X949-33).

Bottom: Alan Ciha, of the USDA Wheat Breeding Research Unit in Pullman, checks wheat varieties being grown under different tillage and crop management systems (0779X950-31A).

Right: No-till planting in standing stubble from previous crops is being tested as a way to reduce soil erosion (0579X644-17).

Epilogue

And how much soil has eroded away
during our years of bounty,
the Prairie People wondered.
And a voice came booming back
. . . "3,000 tons per acre,
you profuse stewards of the land!
I gave you land for a million years,
and you have squandered it in 300!
And you shall wait 100 and 1,000
and 10,000
before you again shall fill your
baskets,"
He said.

. . . Stanley N. Brooks

IPM Controls Pink Bollworm

"Eighteen crop management or genetic features can be identified as suitable for integrated pest management programs for control of pink bollworm in cotton," reports SEA agronomist David L. Kittock.

Kittock says that several of the practices can also reduce populations of other harmful insects such as boll weevil, tobacco budworm, bollworm, and lygus.

Integrated pest management (IPM) is a system of insect suppression that uses more than one practice to control insects and reduce the use of pesticides.

Millions of dollars worth of damage is done each year to the cotton crop by the pink bollworm. Additional millions are spent on chemical control programs. IPM is designed to control insects, eliminate much of the use of pesticides, and protect the environment.

Seven of the 18 practices are readily available for use, have additive benefits — such as increased yield or reduction of labor — and do not appreciably add to cost or reduce lint yields.

Among those seven are resistant varieties, nectariless cotton, steep narrow beds, early varieties, management for earliness, early planting, and crop rotation.

Several studies show that overwintering pink bollworms are reduced by 60 percent through elimination of the last two irrigations. That technique has the same effect as chemical termination of late bolls. Many pink bollworms overwinter in late nonproductive bolls and form a nucleus for the spring insect population.

Chemical termination — spraying growth regulators on the late season crop to halt the growth of late-season bolls — and the elimination of one late irrigation, reduced the overwintering generation by 96 percent.

Nectariless cotton varieties — nectaries are small organs on plants that secrete nectar used as food by adult moths — reduced summer population of pink bollworms by 40 percent. The nectariless variety is less attractive to the adult moths and they lay fewer eggs.

Frequent cultivations reduced the first and second generation of pink bollworms by as much as 70 percent. Pupae of the pink bollworm overwinter near the surface of the soil. Burying the pupae under an inch or so of soil makes it almost impossible for the moths to tunnel to the surface and emerge.

"Final evaluation of an integrated program using several of these biological control practices will require the treatment of all cotton in a wide area for at least a year," Kittock says.

Dr. Kittock is stationed at the University of Arizona Cotton Research Center, 4207 E. Broadway Rd., Phoenix, AZ 85040. — (By Paul Dean, SEA, Oakland, Calif.)

Velvetleaf Hangs Tough

After suffering through two plowings per year for 5 years, an experimental velvetleaf plot still contained 8 percent of the original seed, about 85 ungerminated seeds per square foot.

Two research agronomists used an experimental field that had been planted to velvetleaf for several years to evaluate the effects of seven tillage and cropping systems on the velvetleaf seed population.

When they started the project in 1974, soil samples showed about 53 million velvetleaf seeds per acre or more than 1,200 per square foot. During the 5-year project, plants not controlled by cultural practices were removed by hand so that no new velvetleaf seeds were produced on the plots.

The seven cultural systems and the percentage of ungerminated velvetleaf seeds still left in the soil were: continuous alfalfa, 39; chemical fallow without cultivation, 27; corn-soybean rotation with pre-emergence herbicides and fall plowing, 18; continuous fallow with fall plowing, 13; continuous oats with post-emergence herbicides and fall plowing, 12; continuous corn with pre-emergence herbicides and fall plowing, 8; and continuous fallow with two plowings, 7.

The scientists, William E. Lueschen of the University of Minnesota, stationed at the Southern Experiment Station, Waseca, MN 55093, and Robert N. Andersen, SEA-AR at St. Paul, MN 55108, say their study demonstrates the extreme difficulty of eradicating a velvetleaf infestation. — (By Ray Pierce, SEA, Peoria, Ill.)

Timothy Hay—Japan Market Reopens

Design an export fumigation treatment that would prevent introduction of Hessian fly into Japan in baled timothy hay shipped from the Pacific Northwest.

SEA entomologists Charles L. Storey and Jimmy H. Hatchett, Manhattan, Kans., received this assignment because an export market worth $7 to $10 million annually was at stake. Timothy hay from the Kittitas Valley and Columbia Basin in Washington had been rejected by Japan's plant quarantine inspectors because it contained prohibited plant materials.

The entomologists' research led to reopening of this market. Shipments of timothy hay in the first month were valued at about $1 million — but their assignment was hardly routine.

Timothy is not a reported host of Hessian fly in the United States. Hessian fly is primarily a pest of wheat. Other small grains and several grasses of the tribe *Hordeae* — which does not include timothy — are satisfactory host plants.

The few reports of Hessian fly in Washington since the 1930's also caused agriculturists to question whether the insect is established in the state. In 1932, the fly had only been found west of the Cascade Mountains, not the area shipping most of the timothy to Japan.

And postharvest fumigation studies to kill Hessian fly had never been done. Neither had occurrence or survival of this pest been demonstrated in plant materials cut, baled, stored, and shipped with timothy hay.

The Hessian fly problem began when Japanese quarantine inspectors found stems and leaves of *Agropyron*-species grasses as well as wheat and barley straw in bales of U.S. timothy hay. Japan's regulations prohibit entry of such plant materials because they might serve as hosts of the Hessian fly, a pest not established there.

Appeals to the U.S. agricultural attache in Tokyo from both the exporters and Japanese hay buyers resulted in a request for help from the Foreign Agricultural Service to SEA and the Animal and Plant Health Inspection Service. SEA assigned a research team bringing together Storey's expertise on fumigation and Hatchett's on the Hessian fly.

Eliminating the prohibited materials from hay shipments was not practical. *Agropyron*-species grasses grow

throughout the hay-producing area. And rotation of wheat and hay in the same fields allows establishment of volunteer wheat plants in new hay fields.

The Japanese Ministry of Agriculture, Forestry, and Fisheries indicated it would consider amending its quarantine law. But only if USDA would develop a fumigation procedure and demonstrate its complete effectiveness against test Hessian flies placed in baled hay that was fumigated under actual shipping conditions.

APHIS was also asked for a procedure to verify and document an approved treatment.

Field surveys by Hatchett in cooperation with entomologist Keith S. Pike of Washington State University, Prosser, confirmed that Hessian fly is indeed established in Washington. They found light to heavy infestations in western counties and also light to moderate numbers in central and south-central areas where it had not been reported before.

Preliminary laboratory fumigation tests at Manhattan with aluminum phosphide indicated that some Hessian fly larvae and pupae (puparia) are extremely tolerant to treatment at 70°F (21.1°C) or below.

These tests indicated a necessary dosage rate of 300 phosphide pellets per 1,000 cubic feet (28.3 cubic meters), the maximum permitted by label registration, and an exposure time of 7 days. Smaller dosages or shorter exposure time resulted in fly survival at 50°F (10°C), the lowest hay bale temperature permitted for assured effectiveness.

The entomologists worked with the Washington State Department of Agriculture and hay producer-exporters organized by Ron T. Anderson, president of the National Hay Association, in planning research strategy and assembling shipping containers, hay, and personnel for tests meeting the strict conditions required by the Japanese.

Baled hay for fumigation tests in Washington was loaded in aluminum containers 40 feet (12 meters) long used for export shipments. The tests provided data for establishing dosage, exposure time, temperature limitations, method of aluminum phosphide treatment, and aeration or degassing procedure after fumigation.

Insects for the tests were reared on wheat seedlings in a Manhattan greenhouse. About 25,000 puparia per test were transported to Washington, where they were inserted in bales that were placed at four places in each container. After fumigation, the puparia were returned to the greenhouse in Kansas for observations on adult emergence.

The entomologists exposed only puparia because other Hessian fly stages would not survive on nonliving plant material such as straw and grass stems in baled hay.

The fumigation procedure met the requirements established by the Japanese.

Any possible Hessian fly contamination in baled hay was effectively controlled. Fumigation concentrations were below the maximum allowable at shipment. And phosphide residues left in hay after treatment were below the internationally accepted maximum of 0.1 parts per million.

When results of the tests were presented to Japanese officials in Tokyo, they agreed to permit resumption of U.S. shipments to Japan, provided the hay is fumigated under guidelines proposed by SEA and treatment is verified by APHIS. The U.S. team responsible for negotiating the agreement included agricultural attache Dudley D. Williams of USDA's Foreign Agricultural Service (FAS), Storey, Harold S. Shirakawa of APHIS, and Anderson, representing the growers.

Dr. Charles L. Storey is at the U.S. Grain Marketing Research Laboratory, 1515 College Ave., Manhattan, KS 66502. Dr. Jimmy H. Hatchett's address is 39 Waters Hall, Kansas State University, Manhattan, KS 66505.— (By Walter W. Martin, SEA, Peoria, Ill.)

The timothy hay fumigation study produced both bad and potentially good news for Pacific Northwest wheat growers.

The bad news is (1) that the Hessian fly is established in Washington, and (2) that 34 varieties or germplasm sources used by wheat breeders of the Pacific Northwest are susceptible to the Hessian fly biotype collected in Washington.

The good news is identification by Hatchett and Pike of a potential new source of resistance to Hessian fly. The plant introduction PI 178383 used as a source of disease resistance by Pacific Northwest breeders is tolerant to the Washington Hessian fly.

Hatchett also found that the Washington fly is similar in biotype to those of the Great Plains. Other genetic sources of resistance used by Midwest wheat breeders would also be highly effective against the Hessian fly in the Pacific Northwest.

The Man in the Grapefruit

To agricultural scientists, citrus trees bear a certain resemblance to people.

Citrus leaf photosynthesis activity responds to daily stresses such as dehydration, heat, and age, much like human activity, reports SEA soil scientist Leon H. Allen.

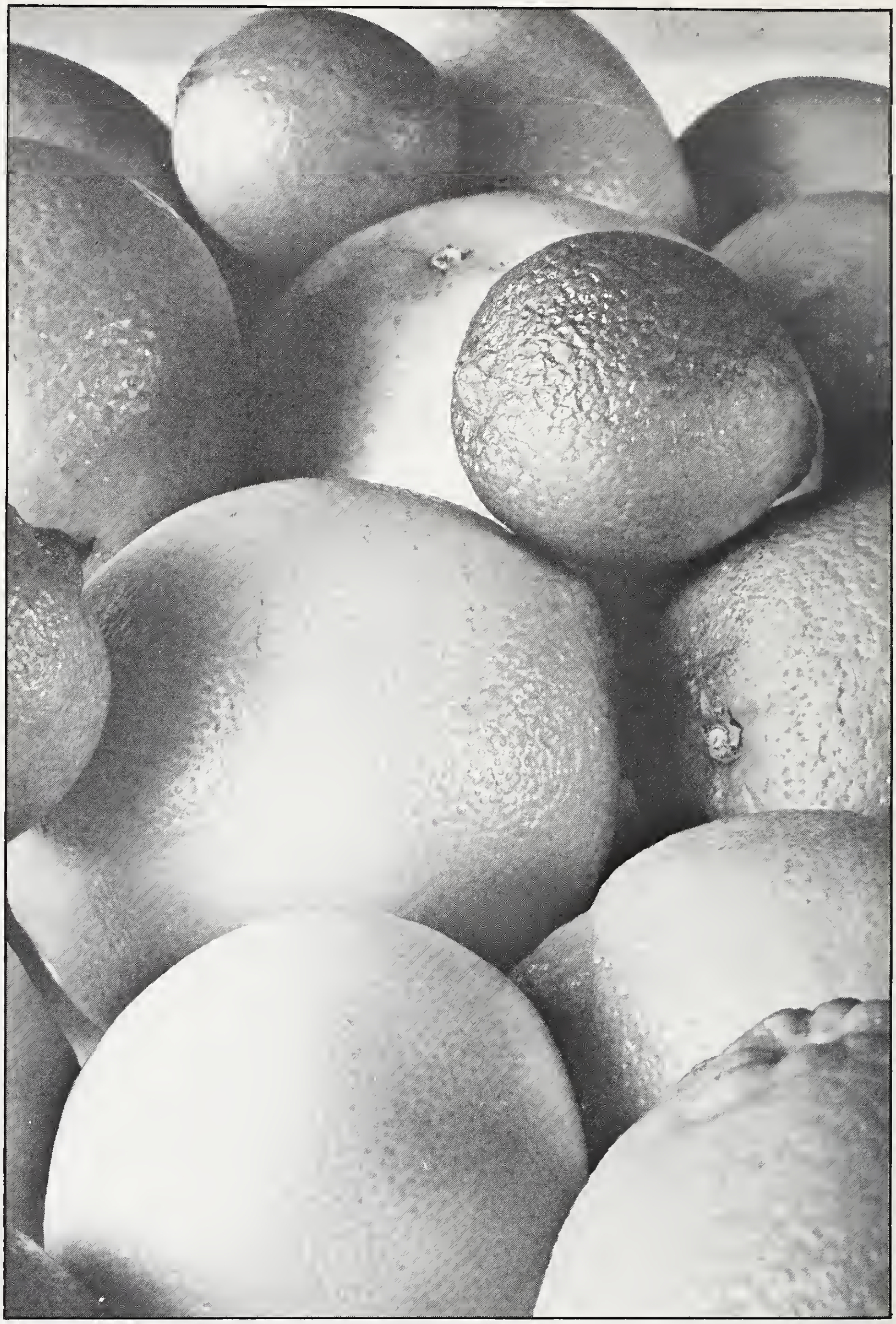
Photosynthesis is the process by which a green plant uses sunlight to convert carbon dioxide and water into food and energy, while replenishing oxygen in the air. Both tree growth and citrus fruit yield depend on the carbohydrates supplied by photosynthesis.

Studies on citrus leaves at Fort Pierce, Fla., showed that photosynthesis starts off like some people — at a rapid pace early in the morning. If the day is very hot or dry, the photosynthesis rates drop significantly around midday or early afternoon, when citrus trees appear to take a noontime "siesta." But if the midday environment is mild, the leaves keep right on working — like people.

"We found that citrus leaves were not adversely affected by increases in solar ultraviolet radiation," Allen said. "Over-exposed leaves seem to develop the long-term ability to absorb more ultraviolet rays right at the surface. This is somewhat like the suntan reaction people get. By absorbing more rays on the surface, the internal cells of the leaves are protected. In this respect, citrus is tougher than corn and soybeans and many other short-term annual crops."

Citrus leaves, in general, do have lower photosynthesis rates than most other annual crops. Anything that reduces photosynthesis reduces the fruit set and yield of oranges and grapefruit. "We are continuing to study environmental factors that affect the vital process of photosynthesis," said Allen, who collaborated on the research with plant physiologist Thomas R. Sinclair and soil scientist Ernest H. Stewart.

Dr. Allen and Dr. Stewart are with the SEA Soil and Water Research Unit at the University of Florida, Room 304 Newell Hall, Gainsville, FL 32611, and the joint SEA-University of Florida Soil-Water-Atmosphere-Plant (SWAP) Research Project. Dr. Sinclair is at the SEA Microclimatology Research Laboratory, Room 1021 Bradfield Hall, Cornell University, Ithaca, NY 14850.— (By Peggy Goodin, SEA, New Orleans, La.)



Cool Citrus Cargo

A new refrigerated barge, capable of transporting intermediate-size loads (20,000 boxes) of perishable products on transoceanic cargoliners, will revolutionize citrus shipments to Europe.

Texas grapefruit growers have been faced with the problem of shipping grapefruit in economic quantities while preserving fruit quality. The new barge should help solve this problem. It has two completely independent cooling and heating systems, one at each end of the barge, designed to refrigerate half of the lower and upper decks.

Shipping citrus as bulk cargo generally requires a consignment of 100,000 to 150,000 7/10 bushel boxes of fruit, often in excess of market demand for a single shipment. Bulk shipment is also relatively expensive, requiring individual handling of the boxes at both ports of shipment and arrival.

Containerized shipments allow for smaller shipments (1,000 boxes/containers), but shipping fees are becoming prohibitive. In addition, refrigerated container vans are not available in any large quantities for citrus because they are used primarily to transport commodities that return higher revenues per van container.

The barge's eight cooling evaporators, totaling 64 tons of refrigeration for both systems, deliver air at the rate of 24,000 ft^3/minute. Power is supplied to operate the refrigeration system by an automatic 100 kw diesel generator on the barge deck. The ship provides the necessary power once the barge is on board the carrying vessel.

Heaters in the duct system assure proper temperatures of the cargo when interior temperatures drop below the desired interior thermostat setting (10°C). Exhaust blowers expel gases given off by the cargo.

Fruit quality was determined at the packinghouse and at the destination in Rotterdam, Holland. Fruit was weighed and evaluated for decay, bruising, and pitting. The quality of the grapefruit upon arrival pleased wholesalers.

The research was conducted by Thomas H. Camp of Transportation and Marketing, P.O. Box ED, College Station, TX 77840, and Dr. William W. Carter, Fruit and Vegetable Postharvest-Quality Maintenance, P.O. Box 267, Weslaco, TX 78596. — (By Eriks Likums, SEA, New Orleans, La.)

Detecting Citrus Canker

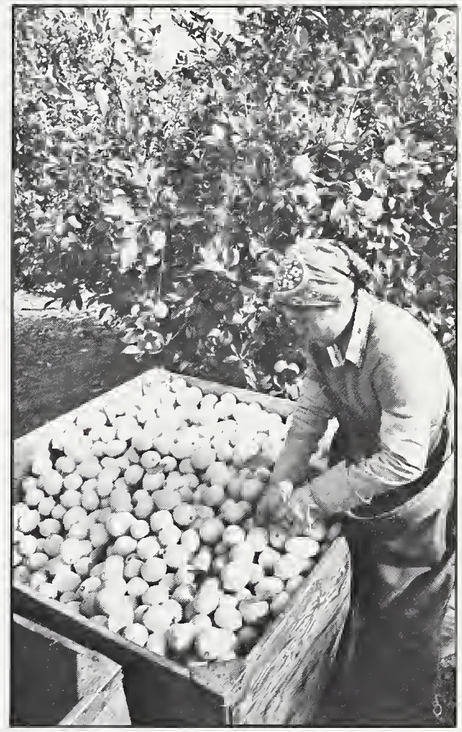
Citrus canker is a devastating bacterial disease that affects citrus trees in Japan, Taiwan, India, and parts of South America. Though citrus canker has not been present in this country for over 40 years, citrus growers fear that it could be accidently introduced. In the last 5 years, customs inspectors have found over 2,500 cases of the disease in intercepted fruit. Now citrus growers have asked SEA scientists to develop a fast, simple, accurate test for detecting this disease in its early stages.

In response to this request, Edwin L. Civerolo, a SEA pathologist, is evaluating a highly sophisticated serological test called ELISA (for enzyme-linked immunosorbent assay) to detect *Xanthomonas citri,* the bacterium that causes citrus canker. This test has been used for some time to detect pathogens in animals, but its use in diagnosing plant diseases is relatively new.

For the test, Civerolo injects a rabbit with *X. citri* cells or a specific component of these cells. He then removes blood from the rabbit, separates out the serum fraction, and places this fraction on a plastic plate. The antibodies from the serum stick to the plate. In successive steps, separated by washing, the test sample, *X. citri*-specific antibody labelled with an enzyme, and a suitable substrate are added to the plate. If the original plant material was infected with *X. citri,* the solution turns a distinct yellow.

Civerolo says the test looks promising, especially since it can be done in a few hours and is sensitive enough to detect low levels of bacteria. Its adaption, along with other confirmatory tests, could give the citrus industry an ace-in-the-hole in the case of a suspected citrus canker outbreak.

Dr. Civerolo is with the Fruit Research Laboratory, B-004, Rm. 111, Beltsville Agricultural Research Center, Beltsville, MD 20705. He is conducting these tests at the USDA's Plant Disease Research Laboratory in Frederick, MD. — the only location in the United States with quarantine facilities that permit the safe study of exotic plant diseases that could pose a threat to our cropland. — (By Mary Ellen Nicholas, SEA, Beltsville Md.)



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Agrisearch Notes

Irrigated Winter Wheat. Winter wheat is not normally an irrigated crop, but rising energy costs and concern about removing too much ground water may change the picture. Farmers who already have center-pivot irrigation systems might be faced with either leaving them idle or using them to irrigate winter wheat, a crop that requires less water than corn.

"Wheat can be irrigated during the fall and spring thus reducing power demands during the critical peak-use summer periods," said SEA soil scientist R. Wayne Shawcroft, Akron, Colo.

If winter wheat is to be irrigated, correct timing of water application makes all the difference in yields and profits. In a field test, wheat plots were treated the same except for the stage of growth when water was applied by sprinkler irrigation. Plots irrigated during the grain filling stage with 1.6 inches of water produced 70 bushels per acre. Plots irrigated only during the vegetative stage with 2.2 inches of water produced 43 bushels. All plots received 2.4 inches of irrigation water in the fall after seeding. Fall rainfall was 1.4 inches, and spring rainfall was 6.8 inches, most of which occurred near the heading stage. Conventional dryland farming (fallow system), used for comparison, produced only 26 bushels per acre.

Early water application after spring growth initiation apparently made plants susceptible to water stress later in the year. With water readily available in the spring, roots did not grow downward far enough to tap water supplies stored deep in the soil profile when irrigation was cut off. Also, early spring irrigations stimulated vegetative growth that led to smaller heads and lower kernel weight.

Dr. Shawcroft cooperated with SEA soil scientist Darryl Smika and research assistant Bohn Dunbar on this 1-year study at the U.S. Central Great Plains Research Station, P.O. Box K, Akron, CO 80720. — (By Dennis H. Senft, SEA, Oakland, Calif.)

Nitrogen Storage in Soil. That nitrate nitrogen can "go into storage" in the soil and then move out again is a condition recently discovered by SEA agricultural physicist Calvin W. Rose.

Rose said that fertilizer in water can move down cracks and channels in the soil and then "go into storage" in soil between the cracks. The fertilizer can come out again much later in other water that seeps down.

The scientist went on to say that only about half the nitrogen fertilizer added to soil is taken up by crops. A good part of the unused fertilizer moves below the reach of crop plant roots.

This "stored" fertilizer can later end up in streams, lakes, and water supplies and thus impair water quality.

"Our objective," said the scientist, "is to maximize uptake of fertilizer by the crop and to minimize losses that could impair water quality."

Dr. Rose is a visiting scientist with the Grassland, Soil and Water Research Laboratory, P.O. Box 748, Temple, TX 76501. — (By Bennett Carriere, SEA, New Orleans, La.)

Keeping Out the Parasites. Chalcid wasps may have to look elsewhere for a meal as insect repellants, commonly used against flies and mosquitoes, can be employed by alfalfa growers to reduce wasp parasitism of alfalfa leafcutter bees during the bees' incubation period. The alfalfa leafcutter bee is the most commonly used pollinator of western alfalfa seed fields.

A problem facing the bee and, as a result, the alfalfa industry, is parasitism of the bee's incubation cell by chalcid wasps. Entire bee colonies can be wiped out by the tiny invaders before any bee emergence takes place. Various types of light traps, cell coverings and cold storage treatments have been tried as a defense with little success.

SEA entomologist Frank D. Parker, Logan, Utah, drastically increased the number of leafcutter bees emerging from incubation leaf cells by treating the cells with deet, an ingredient contained in most commercial repellants. Bees emerging from the treated cells nested adequately and populations more than doubled each season cells were treated.

Parker dipped bee cells into solutions of deet diluted to concentrations of 2-, 6- and 18-percent. The highest bee emergence came from the 6-percent solution. The life span of bees from this treatment was about equal to that of untreated bees.

Liquid insect repellants are available from several commercial sources, with concentrations of deet ranging between 6- and 12-percent. Treating cells allows more leafcutter bees to emerge from incubation, which means a greater number of bees available for alfalfa pollination.

Dr. Parker is located at the Natural Resources Biology Building, Room 261, Utah State University, Logan UT 84322. — (By Lynn Yarris, SEA, Oakland, Calif.)